Effects of Recent Flow Events on the Juvenile Rainbow Trout Population in Lees Ferry

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Introduction and Objectives

The Lees Ferry rainbow trout (*Oncorhynchus mykiss*) fishery has been identified by the Glen Canyon Dam Adaptive Management Program (GCDAMP) as a key resource of the Colorado River below Glen Canyon Dam and so must be maintained. However, nonnative rainbow trout pose a risk to the endangered native humpback chub (*Gila cypha; Yard et al., 2011*), also a key resource identified by the GCDAMP. In order to maintain these two seemingly incompatible resources managers need to identify and understand the most effective tools available to them in this altered system. Discharge flows from Glen Canyon Dam is one of those tools.

The Rainbow Trout Early Life Stage Study (RTELSS) was initiated in 2003 to monitor the effects of different flow regimes on the juvenile population of rainbow trout in Lees Ferry (Korman et al., 2011). Recent flow events include the 2011 equalization flows and the fall High Flow Event (HFE) of 2012. The RTELSS enables monitoring of the effects of these flows on spawn magnitude, and survival and growth through the year.

Methods

The following methods occur on a yearly basis with little year to year variation. All identifiable redds throughout the reach are counted during 8-9 surveys spread over the spawning period of December through May. Counts are entered into a model that returns the total estimated number of redds created for the year. Four electrofishing surveys occur over two day periods each in July, August, September, and November. A total of 40 sites are sampled each trip using both boat and backpack electrofishing methods. Fish are measured to the nearest mm fork length and released. Data collected enable population and survival estimation. A subsample of fish is collected each trip for otolith analysis, which returns growth information (Korman and Campana, 2009).

References

Jeffres, CA, Opperman, JJ, and Moyle, PB (2008) Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. Environ. Biol. Fish. 83:449-458

Korman, J and Campana, SE (2009) Effects of hydropeaking on nearshore habitat use and growth of age-0 rainbow trout in a large regulated river. Trans. of the Amer. Fish. Soc. 138:76-87

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2011 Equalization Flows

Higher than normal flows during the 2011 spawning season led to the highest estimate on record for redds created during a spawn year (Table 1). This was due to continuous inundation of previously marginal spawning habitat that experienced daily dewatering. Elevated discharge continued through the year, inundating large areas of low angle habitat with increased cover and nutrients. Along with decreased daily flow variability, increased water temperature, and increased drift rates of Chironomids (T. Kennedy, unpublished data), all occurring at the appropriate time of year (Fig. 1), environmental conditions in 2011 were a perfect storm for creating and maintaining a high abundance of juvenile rainbow trout (Jeffres et al., 2008). The July population estimate was the second highest on record (Fig. 2), and despite this early high abundance, mortality was low through the year (Fig. 3), leading to the highest November population estimate on record. Otolith analysis (no data shown) indicates that despite the high abundances through the year, growth remained higher than normal until discharge greatly decreased in September.

2012 Fall HFE

The November 2012 HFE seems to have had minimal effects on the age-0 population of rainbow trout. The estimate of the number of redds created in a season for 2013 was higher than the average for all years (Table 1), perhaps due to an increase in spawning substrate quality due to scouring (Korman et al., 2011). July abundance was also a little higher than may have been expected, but normal mortality occurred through the year resulting in a November estimate similar to that of past years (Fig. 2).

Table 1. Number of redd surveys conducted in each month of each year, followed by the total number of surveys conducted for the year, the total count for the year, and the estimate of the total number of redds created for the year for years 2003 through 2013 (no data for 2005).

	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Total Surveys	Total Redd Count	Estimate of Redds
2003			1	1	1	1	1	1		6	2661	2310
2004	1	1	1	2	2	1	2		1	11	3596	2316
2006		1	1	2	2	2	2	1		11	165	90
2007		1	1	1	1	1	1	1		7	1186	1215
2008		1	2	2	2	1	1	1		10	2741	1875
2009	1	1	1	2	2	2	2			11	3078	1713
2010			1	1	1	1	1			5	891	896
2011		1	2	1	2	2	1			9	4433	3062
2012		1	1	2	2	1	1			8	2357	1907
2013		1	1	2	2	1	1			8	3614	2669
											Mean	1805
											SD	881

Provisional Data – do not cite

Fig. 1. Discharge (black, left y-axis) and temperature (red, right y-axis) patterns for 2011 overlaid with the drift pattern for Chironomids (no axis). This figure illustrates the timing of when these critical environmental elements would have been at elevated levels at critical points in the development of age-0 trout. What is not illustrated is the fact that all elements are elevated relative to other years.

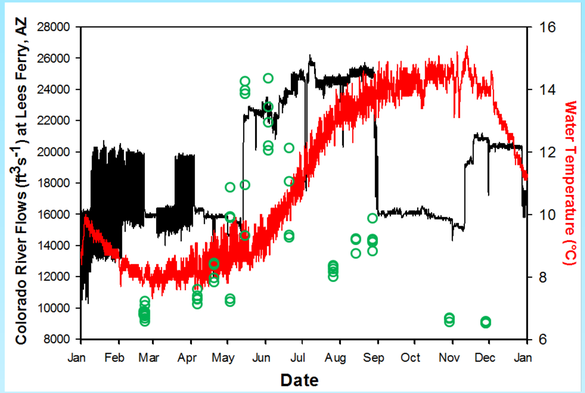

Fig. 2. Population estimates for the four core trips for the most recent years with 95% confidence intervals. Estimates for years prior to 2008 were similar to or below those of 2010.

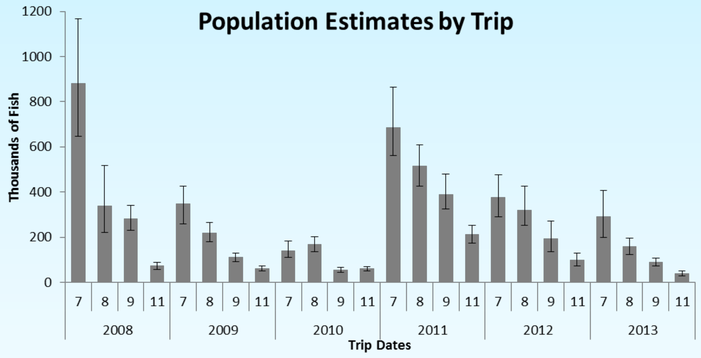
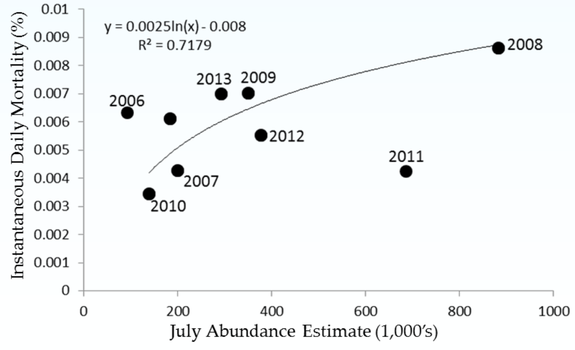
Fig. 3. Mortality rates plotted against July population (abundance) estimates. The line is fitted to all years except 2006 and 2011, which are outliers explained by low O_2 levels (2006) and a large increase in high quality low angle habitat (2011).